Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Analysis of Resource Use efficiency in Bt. Cotton and American Cotton in Sri Ganganagar District of Rajasthan

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ABSTRACT

The study was conducted Irrigated North Western Plain Zone 1b of Rajasthan in agricultural year 2012-13. This zone covers about 80 percent of the total area of cotton in the state. The study focused on the efficiency of resource use. Two villages namely 4C and Mirjawala were selected from Sri ganganagar tehsil of the zone. Sixty farmers were selected at random in proportion to the total number of farmers in each size group from the list of Bt cotton farmers group and similarly another 60 farmers were selected from American cotton farmers group. The Cobb Douglas production function, revealed that the Bt cotton farmers were underutilized seed and human labour inputs, where as American cotton farmers were underutilized fertilizer.

Key word: *MVP/MFC, Resource use efficiency, Bt. cotton, American cotton.*

INTRODUCTION

India ranks first in cotton area in the world and third in production. About 15 million farmers in the country spread across 10 states are engaged in cotton production. Cotton is grown in about 10 million hectares in India and is cultivated in three distinct agro-ecological regions viz., North, Central and South. Out of total, 21 per cent area is under cultivation in North zone which is 100 per cent irrigated and contributes 25 per cent of the production.

The major cotton producing states in the country are Maharashtra, Gujarat, Andhra Pradesh, Punjab and Tamil Nadu. In India 2010-11, the area under cotton was 111.42 lakh hectares and production was 339.00 lakh bales, in 2011-2012 area was 121.78 lakh hectares and production was 353.00 lakh bales and in 2012-2013 area was 119.78 lakh hectares and production was 365.00 lakh bales. Area under cotton in Rajasthan (2010-11) was 3.35 lakh hectares and production was 10.10 lakh bales, area was (2011-2012) 4.70 lakh hectares and production was 18.00 lakh bales and in 2012-2013 area was 4.50 lakh hectares and production was 17.00 lakh bales (bales of 170 kg) [1].

About 80% of the total cotton area of the entire state of Rajasthan is being grown in Irrigated North Western Plain zone Ib. This zone covers Sriganganagar and Hanumangarh districts of Rajasthan.

This is a contiguous area of around 15 lakh ha and the wheat is cultivated in the almost entire area after cotton during the rabi season. Development of early-maturing cotton varieties made it possible to follow cotton-wheat cropping system in a year. Amongst all the pests which attack cotton in India, bollworms namely, American bollworm (*Helicoverpa armigera*), spotted bollworm (*Earias insulana* and *Earias vitella)* and pink bollworm (*Pectinophora* gossipiella) cause major damage. Nearly 54 per cent of the total pesticides are used for the control of pests in cotton alone, out of which about 60 per cent are used for the control of bollworms. Indiscriminate use of pesticides has adversely affected pest control and Farmers and farm workers face acute and chronic health hazards due to their prolonged exposure to pesticides. Eye, skin, pulmonary, neurological and gastro-intestinal problems are associated with long term pesticides exposure [5]. Under these circumstances, Bt. Cotton has emerged as an attractive option for the cotton farmers.

MATERIAL AND METHODS

The present study has been conducted in Irrigated North Western Plain Zone 1b of Rajasthan. This zone covers about 80 percent of the total area of cotton in the state. This zone covers a geographical area of 2.1 m ha spread over Sriganganagar and Hanumangarh districts.

Selection of District

Keeping in view the limited time available with the single handed worker only one district out of the two districts was selected purposively for the study. The selected district was Sriganganagar.

Selection of Tehsil

Looking to the time constraint and facilities available with the single handed worker, only one Tehsil out of the total 9 tehsils of Sriganganagar district was selected purposively. The selected Tehsil was Sriganganagar. This tehsil covers maximum area under Bt. cotton.

Selection of villages

From the selected tehsil Sriganganagar, two villages 4C and Mirjewala having substantial area under Bt. cotton were selected randomly.

Selection of farmers

A list of all the farmers of the selected villages was prepared along with their size of operational land holding and also area under Bt. cotton and American cotton for the previous year 2012-13. The farmers who did not grow cotton were deleted from the list. The farmers from the list were divided into two groups (i) Bt. cotton farmers and (ii) American cotton farmers. The farmers of each group were divided into following three size groups.

(i) Small   Less than 2 ha
(ii) Medium   2-4 ha
(iii) Large   More than 4 ha.

Sixty farmers were selected at random in proportion to the total number of farmers in each size group from the list of Bt. cotton farmers group and similarly another 60 farmers were selected from American cotton farmers group.

Nature and source of data

The information for crop production data from selected farmers were collected on various inputs used & output obtained by survey method through personal interview with the help of a schedule specially designed for the purpose.

Analytical tools and techniques employed

The analytical techniques used to evaluate the objectives of the resent study are summarized below.

Tabular presentation technique

The data collected were presented in tabular form to facilitate easy comparisons. The tabular presentation technique was followed to study the economic characteristics of different size groups of sample farmers, such as size of land holding, cropping pattern, costs and returns in relation to pesticide use by the different farm size holders. The data were summarized with the aid of statistical tools like averages, percentages *etc.* to obtain the meaningful results.

Functional analysis

The Cobb-Douglas type of production function was used to study the effect of various inputs on Bt. cotton and American cotton outputs. On account of its well known property of its computational simplicity, justifies its wide

application in analyzing production relations [3]. The estimated regression coefficients represented the production elasticities.

The form of Cobb-Douglas production function used in the present study is as follows.

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}$$

Where,

Y= Gross returns in Rs. per hectare

a = Intercept

X_1 = Expenditure on seeds (Rs/ha)

X_2 = Expenditure on Plant Protection chemicals (Rs/ha)

X_3 = Expenditure on Fertilizer (Rs/ha)

X_4 = Human labour expenditure (Rs/ha)

X_5 = Machine labour expenditure (Rs/ha)

bi's= Output elasticities of respective factor inputs, i = 1, 2..5 and

The Cobb-Douglas production function was converted into log linear form and parameters (coefficients) were estimated by employing Ordinary Least Square Technique (OLS) as given below.

Log Y = log $a+b_1\log X_1+b_2 \log X_2+b_3 \log X_3+b_4 \log X_4+b_5\log X_5$

The regression coefficients (bi's) were tested using 't' test at chosen level of significance.

Allocative efficiency

Given the technology, allocative efficiency exists when resources are allocated within the farm according to market prices and it implies the proper level of input use in production. To decide whether a particular input is used rationally or irrationally, its marginal value products will be computed. If the marginal value product of an input just covers its acquisition cost it is said to be used efficiently.

The Marginal Value Products (MVP) was calculated at the geometric mean levels of variables by using the formula.

$$MVP\, i^{th}\, resource = bi \times \frac{\bar{y}}{\bar{x}}$$

Where,

MVP = marginal value product

b_i = Regression coefficient i^{th} independent variable

$\bar{y}$ = Geometric mean of the output

$\bar{x}$ = Geometric mean of ith independent variable

In order to determine the efficiency of allocation of the resources or price efficiency, the value of the marginal product obtained by multiplying the marginal product (b_1) by the price of the product was compared with its marginal cost. A ratio of the value of marginal product to the factor price more than unity implied that the resources were advantageously employed. If the ratio was less than one, it suggested that resource was over utilized.

The criterion for determining optimality of resource use was,

MVP/MFC > 1 under utilization of resource

MVP/MFC = 1 optimal use of resource

MVP/MFC < 1 excess use of resources.

RESULTS AND DISCUSSION

The Cobb-Douglass production function was estimated to analyze relationship between resource use and productivity of Bt and American cotton using the data from sample farmers. The gross income in rupees per hectare realized from Bt. Cotton output was taken as dependent variable while expenditure made on seed (Rs), Plant protection chemical (Rs), fertilizers (Rs), human labour (Rs) and machine labour (Rs) were taken as independent variables. The estimates of the production functions are presented in Table-1. The inputs included in model explained 79.6 per cent variation for Bt cotton and 65.1 per cent variation for American cotton as revealed by the coefficient of multiple determination (R^2).

The estimated parameter of seed (0.253) was significant at five per cent, while human labour (0.464) co-efficient was significant at one per cent in Bt. cotton. However pesticides has negative co-efficient for Bt. cotton which is non significant. The estimated parameters in American cotton for pesticides (0.048) was significant at five per cent, while fertilizer at (0.155) co-efficient was significant at one per cent.

Table 1: Estimated Cobb-Douglas Production Function Coefficients in Bt. and American cotton sample farmer

SI. No.	Explanatory Variables	Parameters	Bt. cotton	American cotton
1	Constant	A	1.327 (0.651)	3.830 (0.619)
2	Seed	b_1	0.253** (0.097)	0.072 (0.161)
3	Plant protection chemicals	b_2	-0.024 (0.013)	0.048** (0.020)
4	Fertilizer	b_3	0.052 (0.030)	0.155* (0.045)
5	Human labour	b_4	0.464* (0.064)	0.012 (0.027)
6	Machine labour	b_5	0.126 (0.098)	0.035 (0.039)
	R^2		.796	.651

Note: Figures in the parentheses indicate their respective standard errors

* Significant at one per cent probability level

** Significant at five per cent probability level

Allocative efficiency on Bt. and American Cotton productions

Marginal value productivity at geometric levels was calculated for both Bt and American cotton for various inputs such as seed, fertilizer, plant protection chemicals, human labour and machine labour. The results are presented in table 2. Marginal value productivities (MVP) at factor cost for all these inputs are the same as MVP because all inputs and output values have been taken in monetary terms.

MVP/MFC ratio for Bt. cotton indicates that one rupee investment on the inputs will bring rupees 5.53 in seed and rupees 5.89 in human labour. MVP/MFC ratio for plant protection chemical (-1.72), fertilizer (1.78) and machine labour (3.97) were non significant in Bt cotton. In case of American cotton the MVP/MFC ratio for plant protection chemicals (1.02) this indicates that use of plant protection chemicals was at the optimum level. MVP/MFC ratio for fertilizer was 4.34 which indicate that one rupee additional investment on fertilizer will bring rupees 4.34 returns. Therefore, farmers should use more fertilizers to increase returns from American cotton cultivation. MVP/MFC ratio for seed, human labour and machine labour were found non significant in American cotton.

Table 2: MVP to MFC ratios of resources in Bt. and American cotton Production

S. No.	Particulars	GM	MVP	MVP/MFC ratio
Bt cotton				
1	Gross return	118277		
2	Seed	5413	5.53	5.53
3	Plant protection chemical	1652	-1.72	-1.72
4	Fertilizer	3454	1.78	1.78
5	Human labor	9325	5.89	5.89
6	Machine labor	3763	3.97	3.97
American cotton				
1	Gross return	91785		
2	Seed	3098	2.13	2.13
3	Plant protection chemical	4315	1.02	1.02
4	Fertilizer	3275	4.34	4.34
5	Human labor	11178	0.10	0.10
6	Machine labor	3766	0.86	0.86

Note: GM - Geometric mean   MVP - Marginal Value Product

MFC – Marginal Factor Cost

SUMMARY AND CANCLUSION

The Cobb-Douglass production function was estimated to analyze relationship between resource use and productivity of Bt. and American cotton using the data from sample farmers. The gross income in rupees per hectare realized from Bt. Cotton output was taken as dependent variable while expenditure made on seed (Rs), Plant protection chemical (Rs), fertilizers (Rs), human labour (Rs) and machine labour (Rs) were taken as independent variables. The inputs included in model explained 79.6 per cent variation for Bt cotton and 65.1 per cent variation for American cotton as revealed by the coefficient of multiple determinations (R^2) [2].

The estimated parameter of seed (0.253) was significant at five per cent, while human labour (0.464) co-efficient was significant at one per cent in Bt cotton. However pesticides has negative co-efficient for Bt cotton which is non significant. The estimated parameters in American cotton for pesticides (0.048) was significant at five per cent, while fertilizer at (0.155) co-efficient was significant at one per cent.

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Policy implications

Seed, fertilizer and Human labour were the major contributors to the Bt. and American Cotton production. This indicates the importance of these inputs in Bt. and American Cotton production. Therefore, timely supply of these quality inputs to the farmers may be ensured. Bt. cotton farmers should increase the use of seed and human labour in different operations to get higher returns as the coefficients for these inputs were found significant and MVP/MFC ratios of these inputs were found high. American cotton farmers should use more fertilizers to increase returns from American cotton cultivation. Use of plant protection chemical was at the optimum level.

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